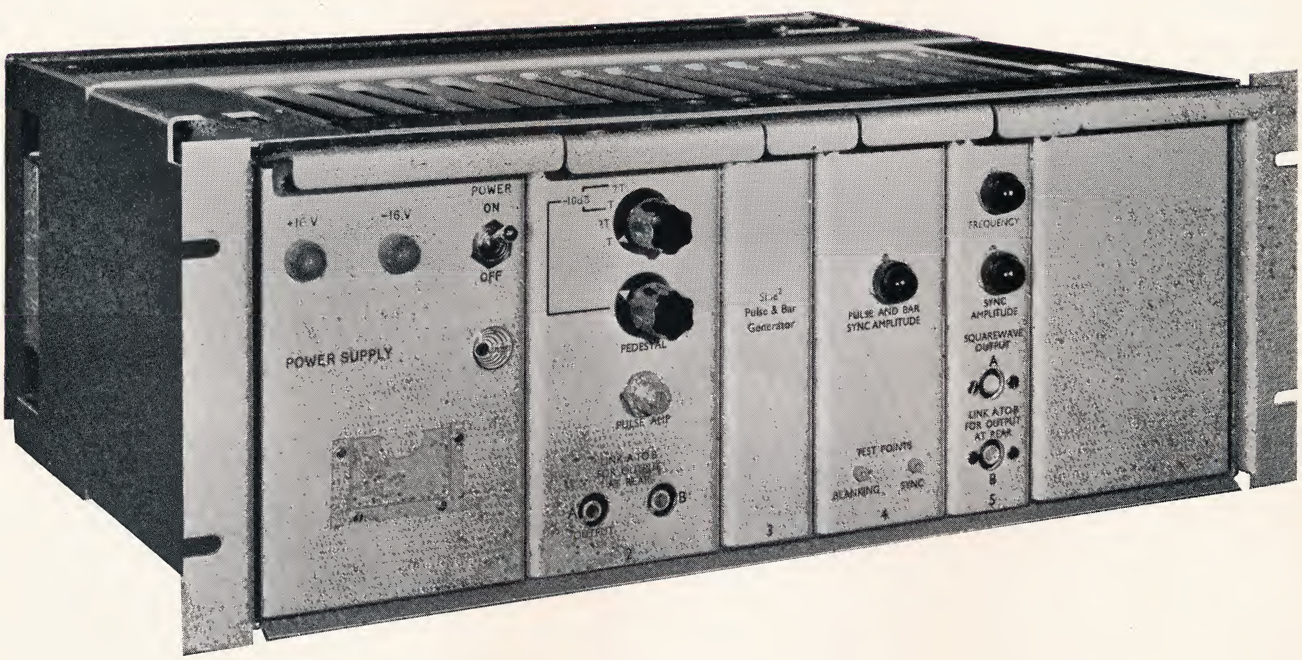
Sine Squared Pulse and Bar Waveform Generator

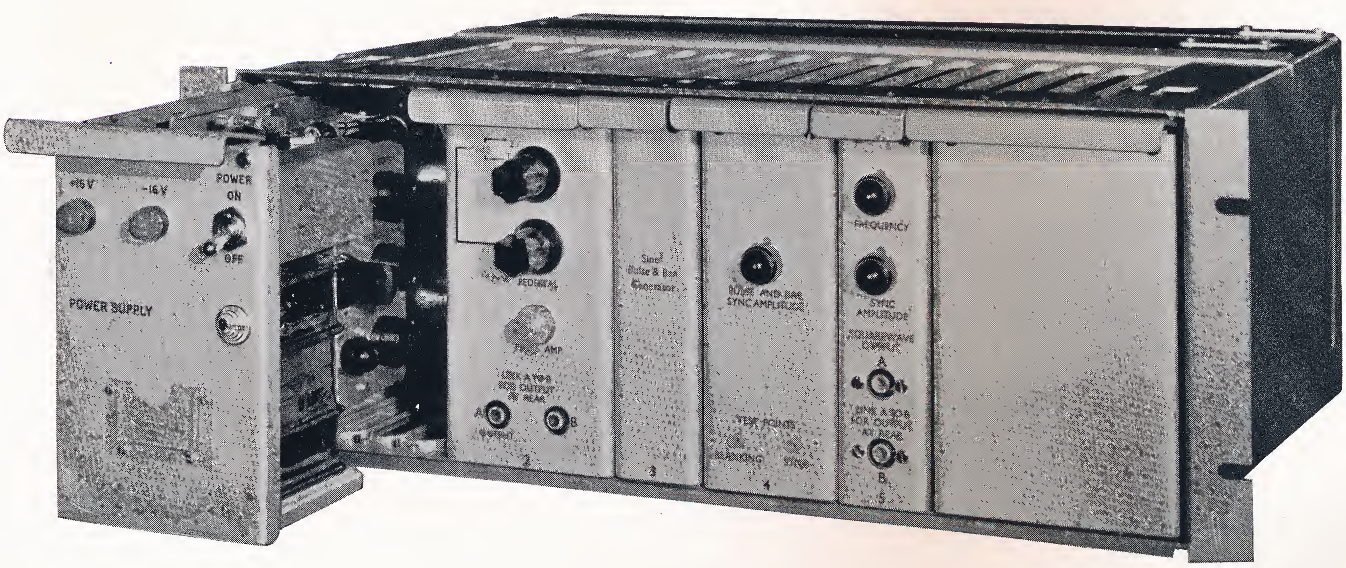
B 4108



MARCONI BROADCASTING

FEATURES

- For day-to-day checking of frequency and phase response of television studio and transmission systems.
- Adjustable sine squared pulse amplitude for checking quadrature distortion in television transmitters.
- All solid-state.
- Pulse and bar waveform complies with C.M.T.T. Test Signal No.2. Field rate square wave output complies with C.M.T.T. Test Signal No.1.
- Minimum jitter due to highly accurate timing of pulse and bar with respect to sync.
- Plug-in modules fit into a 19-inch rack mounting or portable case.



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This illustrates how the units can be easily withdrawn for servicing.

FACILITIES

THE B4108 Pulse and Bar Generator is designed to produce a standard Sine Squared Pulse and Bar Waveform for monochrome Television 525 or 625 line systems. (C.M.T.T. test signal No.2.)

Each line contains a test signal consisting of a sine squared pulse and bar with associated line sync. pulses. The sine squared pulse has alternative half amplitude durations corresponding to T or 2T pulses controlled by a front panel switch. The precise shape and duration of the pulses are determined by pulse shaping networks, and all blanking and sync. waveforms are reformed from the system input pulses.

The pulse and bar part of the waveform can be attenuated by 10 dB's and set up on an adjustable pedestal. This enables quadrature distortion found in television transmitters to be measured.

A composite square wave at field rate corresponding to the C.M.T.T. test waveform No.1 is also available.

The unit is provided with an internally generated line frequency oscillator which enables the pulse and bar output waveform to be free running. Under these conditions no field component is provided and the waveform does not include a front porch. Provision is made for inserting a standard television synchronizing pulse and blanking so that the output waveform conforms to a standard 625 or 525 line signal.

The circuit used to ensure the stability of the pulse and bar waveform is an exclusive Marconi design, enabling a steady jitter-free presentation to be provided on the measuring oscilloscope.

The design of the B4108 Generator, with regard to jitter, has resulted in a performance that is better than 35 parts in 10^6 with reference to the front edge of the sync. pulse.

Introduction

THE use of the Sine Squared Pulse and Bar Waveform is now fully accepted as a valid method of testing the performance of television equipment and transmission links. The Marconi Sine Squared Pulse and Bar Generator Type B4108 is designed to meet the current demand in the television industry for a semiconductor lightweight instrument which can be easily transported to remote sites. The generator will work from a.c. mains or external batteries and under all conditions, will provide stable jitter-free composite pulse and bar waveforms at line frequency, and square waves at field rate.

Application

Distortion Measurement

THE general method of assessing television waveform distortion is to employ a series of rating factors (derived by the British General Post Office) known as 'K' factors.

The 'K' factor provides a means of relating the waveform distortion to the actual resultant impairment of the final picture, and assigns limits upon different features of the waveform. By means of suitably engraved graticules affixed to the face of a measuring oscilloscope, the 'K' factor can be readily measured and the types of distortion present are revealed. (A full discussion of the significance of the 'K' factor and test graticules is given in C.C.I.R. Recommendation No. 267, Los Angeles 1959).

The sine-squared pulse and bar waveforms were devised by the British General Post Office as the most suitable for measuring, in this manner, line-time and short-time (or transient) waveform distortions. The Marconi Sine-Squared Pulse and Bar Generator Type B4108 produces these waveforms (*see Fig.1*).

Since the measurements are ultimately carried out on a cathode ray oscilloscope it is necessary to ensure that the amplifier of the oscilloscope used for display is of a sufficiently high quality to give the necessary overall frequency response within the desired limits. Also the timebase linearity, measuring facilities and oscilloscope geometry must be adequate.

Where the signal originates some distance away from the point at which measurements are being carried out, as is often the case with television links, it is necessary to employ two oscilloscopes (with identical response characteristics). One of these is used to adjust and set-up the transmitted pulse and bar signal, and the other to measure the distortion on the received signal.

Line-frequency waveform distortion

This type of distortion can take the form of a tilt at line frequency or a variation in frequency response, appearing as a change of level of the bar waveform (reference 'Waveform Distortion in Television Links' – I. F. MacDiarmid).* It can be very accurately assessed using this generator with a test oscilloscope which has a double triggering facility to enable the pulse to be displayed with the bar. By adjusting the variable time delay, provided on the bar display, the bar can be superimposed on the pulse and the bar phased relative to the pulse, using the pulse as an index of bar height as shown in the illustration Fig.1(a).

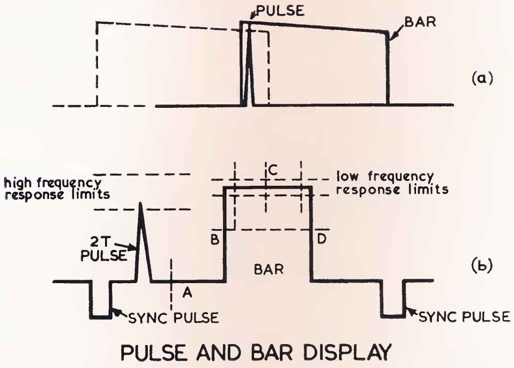

Fig.1

This method eliminates any parallax errors when making the measurements. Alternately, for day-to-day routine tests, an oscilloscope without the double triggering facility can be used as shown in Fig.1(b), by using a graticule engraved to indicate the accepted limits of the response system. The oscilloscope controls are adjusted so as to centre the trace on the points A, B, C and D of the graticule.

* *Post Office Electrical Engineers' Journal Vol.52 parts 2 and 3*

In these tests, the height of the pulse relative to the bar gives an indication of the level of the high-frequency response in relation to the low-frequency response over a bandwidth determined by the half-amplitude-duration (HAD) of the wider pulse width (2T).

After examination, slight adjustments of the circuit variables can be made to obtain a pulse and bar display of equal amplitude and, provided that the overshoots and distortions are within satisfactory limits, the frequency response can then be said to be satisfactory.

Short-time or transient waveform distortion

The high-frequency response of a system can be assessed by means of either the bar edges or the pulse. Since both these waveforms are of a controlled shape (i.e. sine-squared) the oscilloscope display of the response of the system to these waveforms can be compared against a calibrated mask. Typical masks are shown in Figs. 2(a) and 2(b) for bar and pulse waveforms respectively.

The bar response graticule is engraved with the horizontal co-ordinates in μ secs and the vertical co-ordinates as a percentage of amplitude of the signal. The upper and lower limits will depend on the amount of distortion that can be tolerated on a particular line-system. The position and spacing of the vertical lines will depend on the overall bandwidth of the line-system through which the signal has passed.

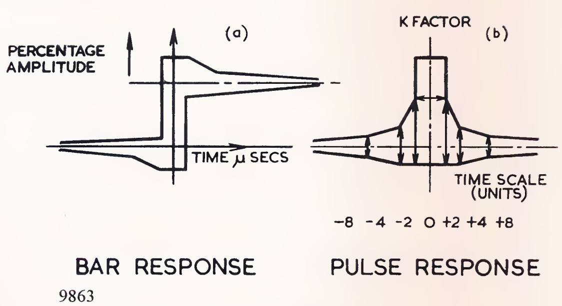

Fig.2 Calibrated masks

The pulse response graticule Fig. 2(b) is for use with the wider (2T) pulse width. The horizontal co-ordinates are engraved with suitable units of time and the vertical co-ordinates are expressed in the terms of the 'K' factor. The outline of the engraving enables a symmetrically distorted pulse, such as is shown in Fig.3, to be centred within the outline; the associated ringing, either side of the pulse edges, should then fall within the engraved limits.

Since a change in the amplitude of the overshoots is readily discernible, this test provides a useful means of ascertaining, from day-to-day, that no change in the performance of the equipment has occurred.

Measurements with the shorter pulse-width (T) are made initially (as for instance during acceptance tests) by photographing the oscilloscope trace, followed by precise measurements using a travelling microscope. However, once this has been done and a satisfactory response obtained, the 2T pulse can be used on a day-to-day basis as a qualitative check to determine that the response has not changed.

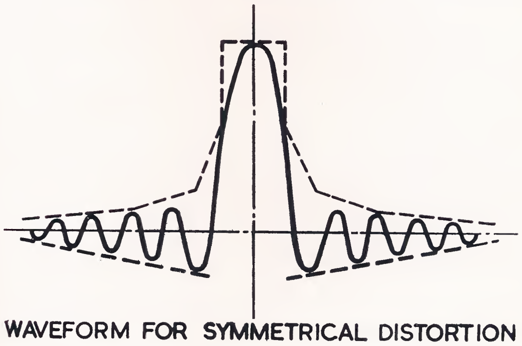

Fig.3

Symmetrical distortion

This type of distortion of the bar or pulse is due to amplitude/frequency distortion of the system without phase distortion. For example, a 'ring' will often occur at or near the cut-off frequency of the system. Fig.3 shows an example of this type of distortion, i.e. the pulse is symmetrical about a vertical line drawn through the point of maximum amplitude of the pulse.

Asymmetrical distortion

Where the pulse of bar transient is asymmetrical about the mid axis, phase distortion must be present. In general in video circuits amplitude/frequency

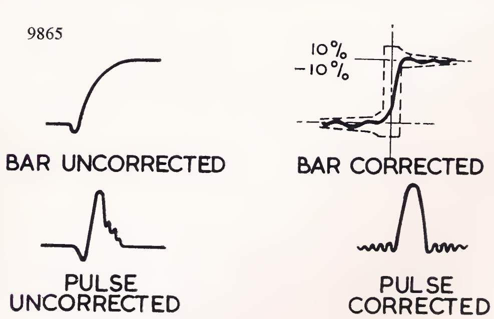

Fig.4

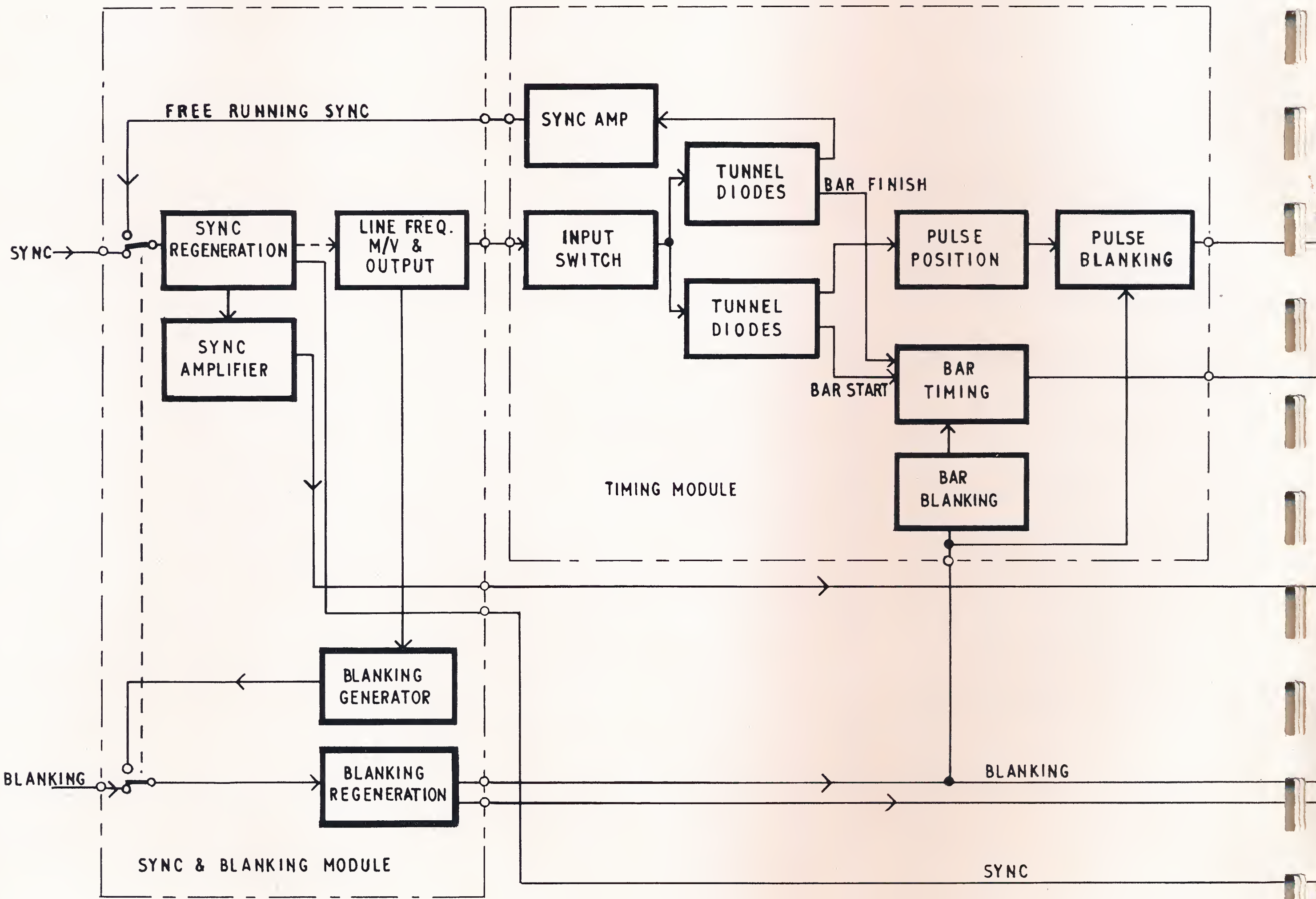

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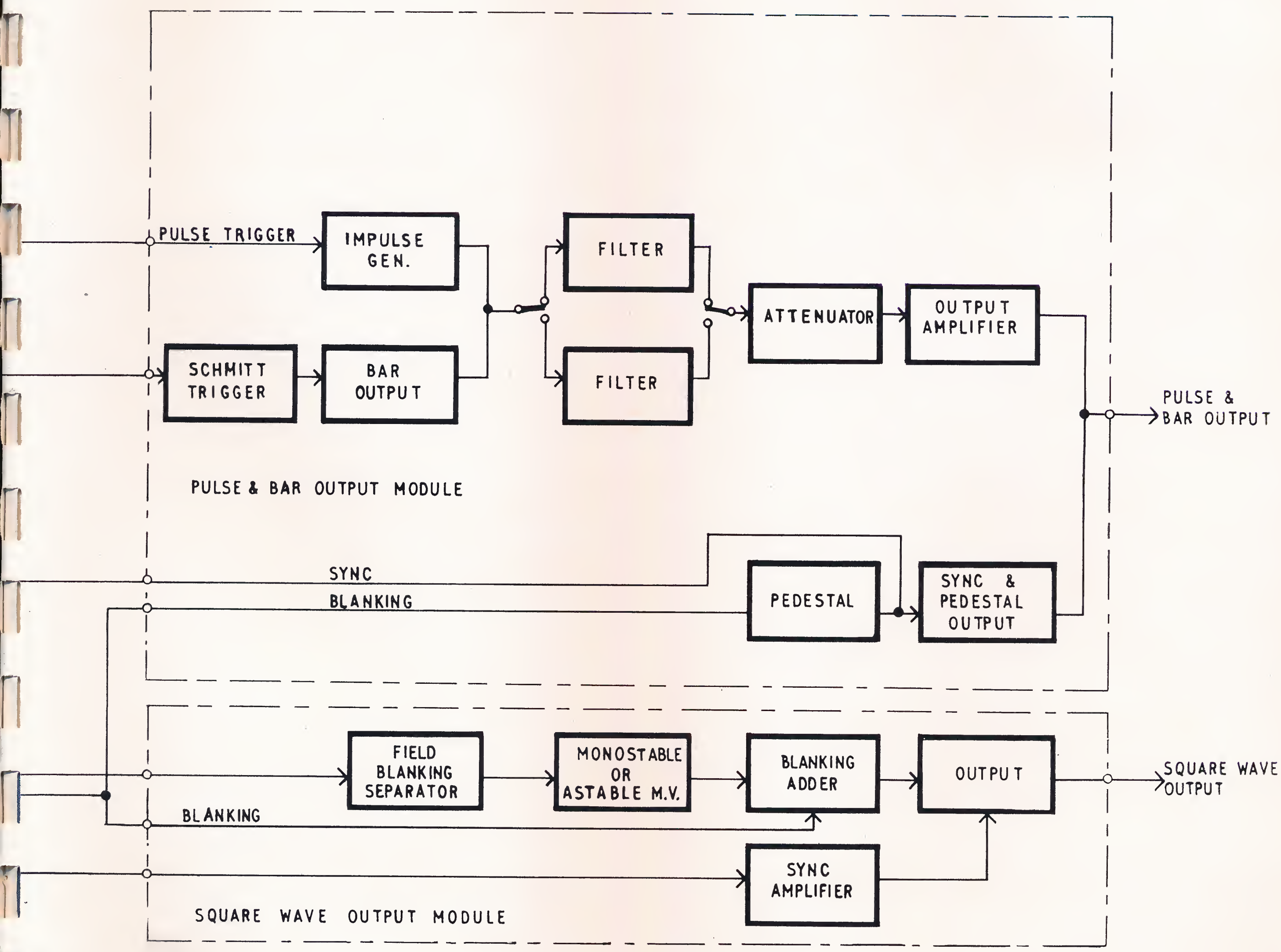
Fig. 5
Block Diagram

Sine Squared Pulse and Bar Waveform Generator



distortion will be present also, and the system will be one described as having minimum phase shift properties. When, therefore, the amplitude distortion is corrected, the phase distortion is corrected at the same time. An example of such a minimum phase shift network is the response of the normal video amplifier. Cases do occur where phase distortion alone is present, the most common being the vestigial sideband receiver. The diagrams in Fig.4 show the bar and pulse response of an actual vestigial sideband receiver.

Quadrature phase distortion

The vestigial-sideband transmitter and ancillary equipment in a television system usually suffers from a non-linear phase characteristic in the region of the carrier frequency. In the receiver this can result in quadrature distortion which has the effects on the pulse shown in Fig.6. This type of distortion produces overshoots on a transient, and harmonic distortion is apparent when the frequency/amplitude response of a system is being measured. The distortion increases with depth of modulation.

It is therefore desirable to test the transmitter or receiver with a transient waveform at low modulation depths. The Pulse and Bar Generator Type B4108 can provide this type of signal as it incorporates a specially designed built-in attenuator

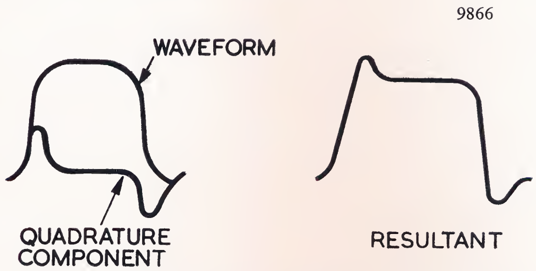


Fig.6 Effects of quadrature distortion

which only affects the pulse and bar signal and not the synchronizing signals. The pulse and bar signals can therefore be attenuated and positioned (relative to the white and black levels) by means of a SET-UP AMPLITUDE control provided. This allows the transient response from black to white to be tested at low modulation depths, which greatly minimizes the effects of quadrature distortion.

Construction

THE unit is built into a 19-inch rack mounting frame 7 inches in height. This comprises five modules which plug into a common frame using 16-way gold-plated connectors. Each module consists of one or more printed wiring boards mounted on a metal panel which carries all the operational controls. The power supply unit is module 1, and is on the left of the frame viewed from the front. The four signal modules are mounted across the frame and all are equipped with quick release catches.

In the case of mobile applications, a carrying case can be provided into which the standard rack mounting can be inserted.

All operational controls are front panel mounted and these are contained on two modules only. The pulse and bar output module contains the T or 2T switch, 10 dB pulse attenuation switch and pedestal amplitude controls. A further preset potentiometer controls pulse and bar sync. pulse amplitude.

Two preset controls on the square wave output module control sync. amplitude and square wave frequency when the unit is free running.

For mobile use the output waveforms are available at the front panel. Standard P.O. 'U' Links are provided to route the signals to the rear of the unit for use in equipment racking.

Circuit Details

A block diagram of the Sine Squared Pulse and Bar Waveform Generator is given in Fig.5.

Two separate signal waveforms are derived from the unit and these may be synchronous with system blanking, or free running depending upon the position of the FREE RUNNING/DRIVEN switch.

Pulse and bar output

Systems syncs. and blanking are fed to the sync. and blanking module where both are regenerated. Amplified sync. pulses are used to trigger the line frequency multivibrator circuit and to provide composite waveforms at the generator outputs.

In the free running state, line syncs. and blanking are generated internally and no equalizing or field frequency syncs. are provided.

The timing module includes circuitry to determine the start and finish of the bar and the position of the pulse. Incoming blanking is used to suppress both the pulse and bar during blanking periods. In the free running condition, a separate output is used to provide a sync. pulse which is amplified and then fed back to the sync. and blanking module via an amplifier.

Inputs to the pulse and bar output module trigger an impulse generator and Schmitt trigger circuit. The bar waveform is mixed with the output of the impulse generator and passes through either a T or 2T filter. These filters shape the pulse and bar waveform which is fed direct, or attenuated by 10 dB, before being fed into the output amplifier. Syncs. and pedestal are added to the output waveform to form the final composite pulse and bar waveform.

Field frequency square wave

The field frequency square wave is produced in the square wave output module, using regenerated system blanking to drive a multivibrator circuit after field blanking information has been separated out. Blanking and sync. pulses are added to the waveform to form the final output signal.

Under free running conditions, line sync. and blanking is generated internally but as no field frequency information is available, the square wave output is free running.

The stabilized d.c. supplies are provided from the power supply module and this gives positive and negative supplies of 16 volts with respect to earth. Series regulators are employed using shunt stabilizer circuits, each providing 200 mA of current.

Ordering Information

Two editions are available:

B4108–01 for 625-line standard.
B4108–02 for 525-line standard.

The generator is normally supplied with the following modules and those marked * will need to be changed when operating on the alternative standard.

Sync. and Blanking Module.
*Timing Module.
*Pulse and Bar Output Module.
Square Wave Output Module.
Power Supply Unit Module.

When ordering please state:

1) Television standard employed.
2) If extra handbooks are required.
3) If spares are required.
4) Whether extra modules are required for alternative television standard.

Data Summary

INPUTS

Mains:

or

100–125 V and 200–250 V adjustable in 5% steps, 50 or 60 c/s cycles. Power consumption is 19 VA approx.

External Batteries:

2 independent 24 V batteries for +ve and −ve supplies.
Voltage range 21·8 – 29 V.

Signal:
(*only required for driven condition*):

Mixed synchronizing and blanking pulses (1·6 – 8 V peak to peak negative going).
High impedance inputs are provided for bridging purposes.

OUTPUTS

Pulse and bar (T and 2T pulse):

Composite waveform at standard level (0·7 V peak to peak). Sync. amplitude adjustable from zero to standard level (0·3 V peak to peak). Small pedestal adjustable from zero to 10% (0·07 V peak to peak).

Diminished pulse and bar with large pedestal:

Composite waveform 10 dB below standard level (0·22 V peak to peak). Large pedestal adjustable from zero to $\frac{2}{3}$ of standard level (0·47 V peak to peak). Sync. amplitude adjustable from zero to standard level.

Composite field rate square wave
(*separate output*):

Composite waveform at standard level (0·7 V peak to peak). Sync. amplitude adjustable from zero to standard level, d.c. coupled output.

PERFORMANCE

Pulse and bar timing:
(*All timings measured from leading edge of line sync. pulses*)

Sync. pulses are 6·4 μs ±5% (free running).
Pulse start – 12·8 μs ±5%.
Bar start – 32 μs ±5%.
Bar end – 57·6 μs ±5%.
Free running line – 64 μs ±5%.
Free running front porch – 1 μs nominal.
Free running blanking end – 10 μs ±5%.
Pulse and bar jitter – Less than 35 parts, in 10^6.

Pulse and bar general:

HAD. T pulses 0·1 μs (625) or 0·125 (525).
HAD. 2T pulse 0·2 μs (625) or 0·25 (525).
Output impedance: 75 Ω ±3% to 5 Mc/s.
±5% to 8 Mc/s.

Sync. and blanking rise times: 0·2 to 0·25 μs.

Operating temperature range: 0° to +45°C for full performance.
−15° to +50°C max. temp. range.

Composite square wave: Unity ratio under driven or free running conditions. Frequency adjustable 50 to 60 c/s (free running). Output impedance: 75 Ω, ±3% to 5 Mc/s ±5% to 8 Mc/s. Rise times similar to pulse and bar waveform.

Stability: The stability referred to in the text can be expected after the unit has been running for 10 minutes.

Dimensions and weight:

	Height	*Width*	*Depth*	*Weight*
Rack mounting:	$6\frac{15}{16}$ in. (17·6 cm)	19 in. (48·3 cm)	16 in. (40·6 cm)	23 lb (10·5 kg)
Mobile case:	$8\frac{3}{4}$ in. (22·2 cm)	21 in. (53·3 cm)	$16\frac{7}{8}$ in. (43 cm)	4 lb (1·8 kg)

NOTE. The information contained herein is subject to confirmation at the time of ordering.

The Sine Squared Pulse and Bar Waveform Generator mounted in a carrying case.

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